

WHAT IS CLAIMED IS:

- 1                   1.       An internal combustion engine with a plurality of cylinders,  
2       the engine including an intake manifold and an exhaust manifold, the engine being  
3       operated such that the intake manifold pressure generally exceeds the exhaust  
4       manifold pressure, the engine further comprising:  
5                   a low pressure turbocharger including a turbine driven by the exhaust  
6       gases and a compressor having an inlet receiving fresh intake air and an outlet  
7       providing low pressure charge air;  
8                   a high pressure turbocharger including a turbine driven by the exhaust  
9       gases and a compressor having an inlet receiving the low pressure charge air and an  
10      outlet providing high pressure charge air to the intake manifold;  
11                  an exhaust gas recirculation (EGR) system passively routing a portion  
12      of the exhaust gases to the high pressure turbocharger compressor inlet.
- 1                   2.       The internal combustion engine of claim 1 further comprising:  
2                   a charge air cooler between the low pressure turbocharger compressor  
3      outlet and the high pressure turbocharger compressor inlet.
- 1                   3.       The internal combustion engine of claim 1 further comprising:  
2                   a particulate filter located in the EGR system to filter particulate  
3      matter from the exhaust gases prior to introduction to the high pressure turbocharger  
4      compressor inlet.
- 1                   4.       The internal combustion engine of claim 1 further comprising:  
2                   an EGR cooler located in the EGR system to cool the exhaust gases  
3      prior to introduction to the high pressure turbocharger compressor inlet.
- 1                   5.       The internal combustion engine of claim 1 further comprising:  
2                   a particulate filter located in the EGR system to filter particulate  
3      matter from the exhaust gases prior to introduction to the high pressure turbocharger  
4      compressor inlet; and

5 an EGR cooler located in the EGR system downstream of the  
6 particulate filter to cool the exhaust gases prior to introduction to the high pressure  
7 turbocharger compressor inlet.

1 6. The internal combustion engine of claim 1 further comprising:  
2 a charge air cooler between the low pressure turbocharger compressor  
3 outlet and the high pressure turbocharger compressor inlet;  
4 a particulate filter located in the EGR system to filter particulate  
5 matter from the exhaust gases prior to introduction to the high pressure turbocharger  
6 compressor inlet; and  
7 an EGR cooler located in the EGR system downstream of the  
8 particulate filter to cool the exhaust gases prior to introduction to the high pressure  
9 turbocharger compressor inlet, wherein the exhaust gases are introduced at a  
10 location downstream of the charge air cooler.

1 7. The internal combustion engine of claim 1 wherein a  
2 compression ratio of the low pressure turbocharger is greater than a compression  
3 ratio of the high pressure turbocharger.

1 8. The internal combustion engine of claim 7 wherein the  
2 compression ratio of the low pressure turbocharger is greater than 1.5 times the  
3 compression ratio of the high pressure turbocharger.

1 9. A method of controlling an internal combustion engine with  
2 a plurality of cylinders, the engine including an intake manifold and an exhaust  
3 manifold, the engine being operated such that the intake manifold pressure generally  
4 exceeds the exhaust manifold pressure, the engine including a low pressure  
5 turbocharger including a turbine driven by the exhaust gases and a compressor  
6 having an inlet receiving fresh intake air and an outlet providing low pressure  
7 charge air, and the engine further including a high pressure turbocharger including  
8 a turbine driven by the exhaust gases and a compressor having an inlet receiving the  
9 low pressure charge air and an outlet providing high pressure charge air to the  
10 intake manifold, the method further comprising:

11                   passively routing a portion of the exhaust gases to the high pressure  
12 turbocharger compressor inlet to provide exhaust gas recirculation.

1                   10.    The method of claim 9 further comprising:  
2                   cooling the low pressure charge air from the low pressure  
3 turbocharger compressor outlet prior to the high pressure turbocharger compressor  
4 inlet.

1                   11.    The method of claim 9 further comprising:  
2                   filtering particulate matter from the exhaust gases prior to  
3 introduction to the high pressure turbocharger compressor inlet.

1                   12.    The method of claim 9 further comprising:  
2                   cooling the exhaust gases prior to introduction to the high pressure  
3 turbocharger compressor inlet.

1                   13.    The method of claim 9 further comprising:  
2                   filtering particulate matter from the exhaust gases prior to  
3 introduction to the high pressure turbocharger compressor inlet; and  
4                   after filtering, cooling the exhaust gases prior to introduction to the  
5 high pressure turbocharger compressor inlet.

1                   14.    The method of claim 9 further comprising:  
2                   cooling the low pressure charge air from the low pressure  
3 turbocharger compressor outlet prior to the high pressure turbocharger compressor  
4 inlet;  
5                   filtering particulate matter from the exhaust gases prior to  
6 introduction to the high pressure turbocharger compressor inlet; and  
7                   after filtering, cooling the exhaust gases prior to introduction to the  
8 high pressure turbocharger compressor inlet, wherein the exhaust gases are  
9 introduced to cooled low pressure charge air.

1                    15.    The method of claim 9 wherein a compression ratio of the low  
2    pressure turbocharger is greater than a compression ratio of the high pressure  
3    turbocharger.

1                    16.    The method of claim 15 wherein the compression ratio of the  
2    low pressure turbocharger is greater than 1.5 times the compression ratio of the high  
3    pressure turbocharger.